

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
14 October 2004 (14.10.2004)

PCT

(10) International Publication Number
WO 2004/088914 A1

(51) International Patent Classification⁷: H04L 7/04,
7/10, 27/00, 27/26

(21) International Application Number:
PCT/JP2004/004495

(22) International Filing Date: 30 March 2004 (30.03.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2003-094926 31 March 2003 (31.03.2003) JP

(71) Applicant (for all designated States except US): MAT-
SUSHITA ELECTRIC INDUSTRIAL CO., LTD.
[JP/JP]; 1006, Oazakadoma, Kadoma-shi, Osaka 571-8501
(JP).

(72) Inventors; and

(75) Inventors/Applicants (for US only): OMOTO, Yukihiro.
SHIRAKATA, Naganori. URABE, Yoshio. HARADA,
Yasuo.

(74) Agent: NAKAJIMA, Shiro; 6F, Yodogawa 5-Bankan,
2-1, Toyosaki 3-chome, Kita-ku, Osaka-shi, Osaka
531-0072 (JP).

(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN,
CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI,
GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE,
KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD,
MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG,
PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM,
TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM,
ZW.

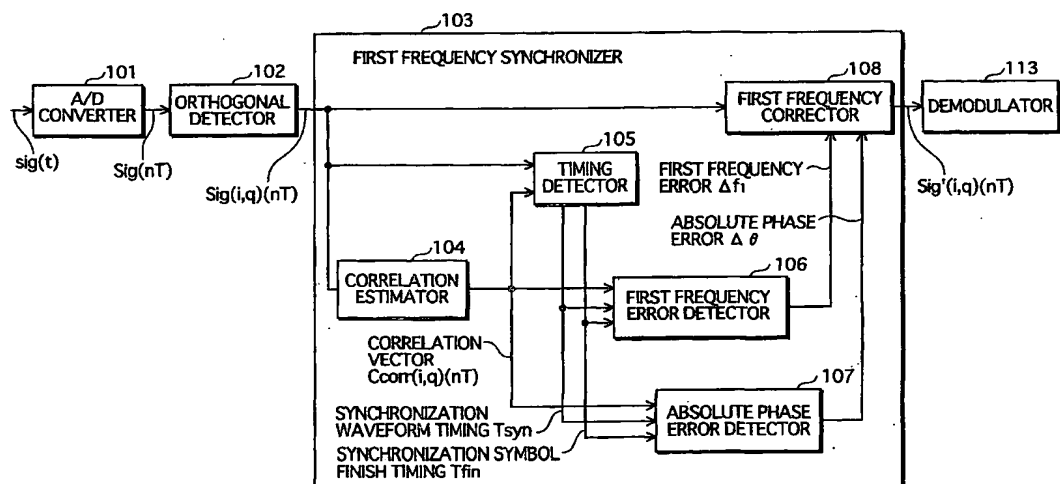
(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), Euro-
pean (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR,
GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
ML, MR, NE, SN, TD, TG).

Published:

- with international search report
- with amended claims

For two-letter codes and other abbreviations, refer to the "Guid-
ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: FREQUENCY SYNCHRONIZATION APPARATUS AND FREQUENCY SYNCHRONIZATION METHOD



(57) Abstract: A first frequency synchronization unit (103) corresponds to the frequency synchronization apparatus of the present invention. A higher apparatus that is, for example, a wireless receiver supplies a reception signal to the first frequency synchronization unit (103) via an A/D converter (101) and an orthogonal detector (102). A synchronization symbol that includes a predetermined waveform at least twice is incorporated into the reception signal. A correlation estimator (104) generates a reference signal expressing the same waveform as the synchronization symbol, and successively finds correlation vectors between the reception signal and the reference signal. A first signal error detector (106) finds a frequency error based on an average phase difference of predetermined correlation vectors, and finds an absolute phase error based on transition of absolute phase of predetermined correlation vectors. A first frequency corrector (108) simultaneously gives the reception signal a frequency shift and phase rotation that cancel the errors.